

CLAIMS

What is claimed is:

5 1. A semiconductor component comprising:

a semiconductor layer having a trench with first and second sides, a portion of the semiconductor layer having a first conductivity type and a first charge density;

a control electrode in the trench;

10 a channel region in the semiconductor layer and adjacent to the trench; and

a first region in the semiconductor layer, having a second conductivity type, and having a second charge density balancing the first charge density.

15 2. The semiconductor component of claim 1, wherein:

the semiconductor layer has a first surface and a second surface;

20 a first portion of the first region is at the first side of the trench and extends along a height of the semiconductor layer from the first surface of the semiconductor layer toward the second surface of the semiconductor layer; and

25 a second portion of the first region is at the second side of the trench and extends along the height of the semiconductor layer from the first surface of the semiconductor layer toward the second surface of the semiconductor layer.

30 3. The semiconductor component of claim 2, wherein the first region is discontinuous.

4. The semiconductor component of claim 3, wherein the first portion of the first region is discontinuous.

5. The semiconductor component of claim 2, wherein the first region is continuous.

6. The semiconductor component of claim 5, wherein the
5 first region is continuous from the first surface of the semiconductor layer toward the second surface of the semiconductor layer.

7. The semiconductor component of claim 2, wherein:
the first region is contiguous with the first surface
10 of the semiconductor layer; and
the trench is in the second surface of the
semiconductor layer.

8. The semiconductor component of claim 2, wherein the channel region is between the first and second portions of
15 the first region.

9. The semiconductor component of claim 1, further comprising an electrically insulative layer in the trench
20 between the semiconductor layer and the control electrode.

10. The semiconductor component of claim 1, wherein the control electrode is located only in the trench.

11. The semiconductor component of claim 10, wherein:

the semiconductor layer has a first surface and a second surface;

the trench is in the second surface of the

5 semiconductor layer; and

the semiconductor component further comprises a second region in the semiconductor layer, at the second surface of the semiconductor layer, having the first conductivity type, and contiguous with the trench.

10 12. The semiconductor component of claim 1, wherein:

the semiconductor layer has a first surface and a second surface;

the trench is in the second surface of the semiconductor layer; and

the control electrode overlaps the second surface of the semiconductor layer.

15 13. The semiconductor component of claim 12, further comprising a second region in the semiconductor layer, at the second surface of the semiconductor layer, having the first conductivity type, and adjacent to and non-contiguous with the trench.

20 14. The semiconductor component of claim 1, wherein the trench extends into the semiconductor layer deeper than the channel region.

25 15. The semiconductor component of claim 1, wherein the channel region is absent underneath the trench.

30 16. The semiconductor component of claim 1, wherein the first region is absent underneath the trench.

17. The semiconductor component of claim 1, wherein the portion of the semiconductor layer is located under the trench.

5 18. The semiconductor component of claim 1, wherein:
the semiconductor layer has a first surface and a second surface;

10 a first portion of the first region is at the first side of the trench and extends along a height of the semiconductor layer from the first surface of the semiconductor layer toward the second surface of the semiconductor layer;

2015 a second portion of the first region is at the second side of the trench and extends along the height of the semiconductor layer from the first surface of the semiconductor layer toward the second surface of the semiconductor layer; and

the portion of the semiconductor layer is located between the first and second portions of the first region.

19. A semiconductor component comprising:

a semiconductor layer having a first trench with first and second sides, a portion of the semiconductor layer having a first conductivity type and a first charge density;

5 a control electrode in the first trench;

an electrically insulative layer in the first trench between the semiconductor layer and the control electrode;

a channel region in the semiconductor layer and adjacent to the first trench;

10 a first region in the semiconductor layer, having a second conductivity type, and having a second charge density balancing the first charge density, a first portion of the first region at the first side of the first trench, and a second portion of the first region at the second side of the first trench; and

15 a semiconductor substrate underneath the semiconductor layer and having the first conductivity type and a third charge density greater than the first and second charge densities.

20 20. The semiconductor component of claim 19, wherein:

the semiconductor layer has a first surface and a second surface opposite the first surface;

the first trench is located in the second surface of the semiconductor layer;

25 the first region extends continuously along a height of the semiconductor layer from the first surface of the semiconductor layer toward the second surface of the semiconductor layer; and

30 the first region is contiguous with the first surface of the semiconductor layer.

21. The semiconductor component of claim 20, wherein:
the first trench extends into the semiconductor layer
deeper than the channel region;

5 the channel region is absent underneath the first
trench;

the first region is absent underneath the first trench;
and

10 the portion of the semiconductor layer is located under
the first trench and between the first and second portions
of the first region.

22. The semiconductor component of claim 21, wherein:

the semiconductor layer has a second trench in the
second surface of the semiconductor layer; and

15 the second trench extends deeper into the semiconductor
layer from the second surface of the semiconductor layer
than the first trench.

23. The semiconductor component of claim 22, wherein the
second trench extends from the second surface of the
semiconductor layer to the first surface of the
20 semiconductor layer.

24. The semiconductor component of claim 23, wherein the
second trench extends into the semiconductor substrate.

25 25. The semiconductor component of claim 22, wherein the
second trench is contiguous with the first and second
portions of the first region.

26. A method of manufacturing a semiconductor component, comprising:

providing a semiconductor layer wherein at least a portion of the semiconductor layer has a first conductivity type and a first charge density;

5 forming a channel region in the semiconductor layer;

forming a first trench in the semiconductor layer, the first trench having first and second sides and adjacent to the channel region;

10 forming a control electrode in the first trench; and

forming a first region in the semiconductor layer, having a second conductivity type, and having a second charge density balancing the first charge density.

15 27. The method of claim 26, further comprising forming a second trench deeper into the semiconductor layer than the first trench.

28. The method of claim 27, wherein:

forming the first region further comprises:

20 forming a polysilicon layer in the second trench, the polysilicon layer doped with a dopant; and diffusing the dopant from the polysilicon layer into the semiconductor layer to form the first region in the semiconductor layer.

25 29. The method of claim 27, wherein:

forming the first region further comprises:

forming an epitaxial layer in the second trench, the epitaxial layer doped with a dopant; and diffusing the dopant from the epitaxial layer into 30 the semiconductor layer to form the first region in the semiconductor layer.

30. The method of claim 27, wherein:
forming the first region further comprises:
implanting a dopant into second trench and into the
semiconductor layer to form the first region in the
5 semiconductor layer.

Patent Application